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(19) (CA) **CANADIAN PATENT** (12)

(54) Chair

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ABSTRACT OF THE DISCLOSURE

A chair of the swivel and tilting type includes a seat and back supported on a pedestal with the seat and back being pivotal both rearwardly and forwardly from a neutral position in which the seat is substantially horizontal. The principal pivot position for the seat in its relationship to the back is located on each side of the seat at substantially the ideal natural body pivot of the user which is somewhat above the seat and forward of the back. The back pivot is located in the base at the top of the pedestal and essentially vertically below such seat pivot, the link supporting the back also supporting such seat pivotal support. The seat pivotal support may be rocked with the back supporting link fore and aft the neutral position. An L-shape seat cradle is pivotally suspended from the pivotal support and forms one link of a four-bar linkage, the opposite end of the seat cradle being pivoted to a front link, in turn pivoted to a fixed link or such base, as is the link supporting the back. A pair of opposed springs hold the chair in the neutral position and readily return the chair to that position. The described four-bar linkage provides a rearward seat/back tilt ratio of about 1 to 3, and a more limited forward seat/back tilt ratio of approximately 1 to 2, respectively. The four-bar linkage relates the relation of the seat and back to the natural pivot point of the body so that movements of the seat and back remain in parallel with the natural pivotal motions of the body. The arms move in relationship with the seat, being extended when reclining and somewhat retracted when tilting forward. The entire seat and back may be vertically adjusted, the back may be adjusted vertically with respect to the seat, and a spring loaded shoulder support may be provided. The seat on its supporting link or cradle may be adjusted fore and aft to adjust seat depth. In addition, removable, height adjustable arm rests may be provided mounted on the pivotal supports, such arm rest being side-to-side interchangeable to widen or narrow the distance therebetween.

Title: "Chair"

DISCLOSURE

This invention relates generally as indicated to a chair and more particularly to a chair of the tilting type which but in which the seat and back are mounted for limited tilting movement both forwardly and rearwardly.

BACKGROUND OF THE INVENTION

This invention relates to certain improvements in a chair of the tilting type as shown and illustrated in applicant's prior U.S. patent 4,429,917. The chair of such patent is known as the HELENA chair and is marketed by SunarHauserman of Cleveland, Ohio. Such chair utilizes a seat and back which tilt rearwardly in a ratio of approximately 1 to 3. Some of the advantages of such chair are that it eliminates the problem known as "shirt tail pull" and that it may tilt back and return without lifting the feet of the user from the floor. The approximate pivot point for both the seat and back is at the ideal natural body pivot point of the user even though the pivot point is not physically located in such position.

In some task and executive applications, as well as in some work station applications, particularly work stations involving modern computer paraphernalia, it is desirable that the chair also tilt forwardly to a limited degree. It is also desirable that the chair incorporates some additional features of adjustment such as the ability to adjust the width between the arm rests while nonetheless maintaining the efficiencies of the noted seat and back tilting both forwardly and rearwardly. It is desirable to have a chair for executive, task or work station use which literally can be tailored to the individual physical sizes of the user.

The present invention provides a chair useful as an executive chair, a task chair, or at a specialized work station such as utilized for computer or word processing technology. The chair may be of the swivel and tilting type and includes a seat and back which may be supported on a vertically adjustable pedestal. There is provided a linkage means supporting the seat and back for both rearward and forwarding tilting from a neutral position in which the seat is in a substantially horizontal position.

According to another aspect of the invention, there is provided spring means supporting the seat in a stable substantially horizontal position with linkage means supporting the seat and back for limited forward and rearward tilting against the pressure of the spring means.

The principal pivot position for the seat in its relationship to the back is located on each side of the seat and at substantially the ideal natural body pivot of the user which is somewhat above the seat and forward of the back. The back pivot may be located in the base at the top of the pedestal and essentially vertically below such seat pivot. The link supporting the back also supports such principal seat pivot. The principal seat pivot may be rocked with the back supporting link fore and aft the netural position.

According to yet another aspect of the invention there is provided a chair which includes a seat and a pivotal support means for the seat above and on each side thereof. Means is included to rock the pivotal support means both fore and aft a neutral position wherein the seat is substantially horizontal. A seat cradle is pivotally suspended from the pivotal support means supporting the seat. The seat cradle forms one link of linkage means operative to pivot the seat inclined forwardly and also inclined rearwardly.

More specifically, the seat cradle is L-shaped and is pivotally suspended from the principal seat pivot and

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forms one link of a four-bar linkage, the opposite end of the seat cradle being pivoted to a smaller front link, in turn pivoted to the base which forms the fixed link. The link supporting the back and the principal pivot of the seat is also pivoted to such fixed link. The arms are attached to the seat cradle at such ideal natural body pivot and swing fore and aft with the cradle.

In a specific embodiment of the invention a pair of opposed springs hold the chair in the neutral position. The body weight of the user in an ideal position also tends to maintain the seat in such neutral position.

The described four-bar linkage provides a rearward seat/back tilt ratio of about 1 to 3, and a more limited forward seat/back tilt ratio of approximately 1 to 2, respectively. With such tilt ratios the arms move in relationship with the seat, being somewhat extended when the back reclines, and being somewhat retracted when tilting forward. In addition to the vertical adjustment of the base, the back may be adjusted vertically with respect to the seat, and a spring loaded shoulder support may be

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provided at the top of the back. The seat may be adjusted fore and aft on the seat cradle to adjust the seat depth. In addition, removable, height adjustable arm rests may be provided mounted on the principal pivots of the seat and for movement with the seat, such arm rests being readily side-to-side interchangeable to widen or narrow the distance therebetween.

To the accomplishment of the foregoing and related ends the invention, then, comprises the features hereinafter fully described and particulary pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

In said annexed drawings:

Figure 1 is a side elevation of a chair in accordance with the present invention shown in tilted back position;

Figure 2 is an enlarged side elevation of such chair with certain parts omitted, and also, showing the forward and rearward tilting of the seat and back in phanton line positions;

Figure 3 is a rear elevation of the seat seen from the line 3-3 of Figure 2, again with certain parts omitted for clarity of illustration;

Figure 4 is a top plan view of the tilting mechanism as seen from the line 4-4 of Figure 2 with the seat and back removed;

Figure 5 is an enlarged vertical section seen from the line 5-5 of Figure 4 illustrating one of the springs employed to balance the seat and back in a neutral position;

Figure 6 is a similar section taken from the line 6-6 of Figure 4 illustrating the other spring;

Figure 7 is a front elevation of a chair in accordance with the present invention illustrating the arm rests in one position of adjustment;

Figure 8 is a view similar to Figure 7 illustrating the arm rests in an interchanged position or another position of adjustment; and

Figure 9 is a schematic side elevation illustrating the four-bar linkage of the present invention and illustrating with arrows the various adjustments which may be made with respect to the chair and its components.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to Figure 1, it will be seen that the chair comprises a base 10, a seat 11 and a back 12. The base is mounted on a pedestal which includes an upright spindle 14 projecting upwardly from a five-legged frame adapted to support the chair on a floor or carpet by the use of casters 16 at the end of each leg. A pair of arm rests indicated generally at 17 and 18 may be provided extending upwardly on each side of the seat and forwardly of the back.

Initially it should be noted that the spindle 14, in conventional manner, may include a gas spring lifter which includes an upwardly projecting plunger 20 extending from the top of the spindle through a protective boot 21. The gas spring lifter may be operated by an actuator 22 at the side of the chair seen more clearly in Figure 3 which engages a bypass valve through a lever 23. In this manner, the vertical height of the chair may readily be adjusted. Such gas spring lifters are conventional.

The plunger of the gas spring lifter is secured through a wedge lock 25 seen in Figure 4 to the base 10.

The outline of the base in plan, as seen more clearly in Figure 4 is generally T-shape and includes a vertically oriented back wall 27 at the rear of the base which extends completely across the head of the T. The ends of the head of the T are closed by end walls 28 and 29 which are in turn connected to somewhat shorter walls 30 and 31, respectively forming the underside of the head of the T as seen in Figure 4. Connected both to such walls and to the back wall 27 are forwardly projecting side walls 33 and 34.

Also extending forwardly of the back wall 27 are two intermediate walls 35 and 36 which are welded to the hub 37

housing the wedge lock 25 for the spring plunger 20. Such walls are also interconnected by a rigidifying wall 38 near the front of the base.

The walls 35 and 36 also provide in cooperation with the outer walls housing for springs 40 and 41, the function and operation of which will hereinafter be described. The walls 33 and 35 are interconnected by transverse walls 43 and 44 as well as the back wall 27, as seen more clearly in Figure 6. The walls 36 and 34 are interconnected by transverse walls 46 and 47, as well as the back wall 27, as seen more clearly in Figure 5. The wall structure above described for the springs and supporting the chair on top of the gas spring plunger of the spindle comprises a mechanism housing and may be fabricated of aluminum by weldments or cast in metal as a single unit.

Extending through the rear of such base or housing is a cross shaft 50 which may be mounted in the various vertical walls within plastic bearings 51. As seen more clearly in Figures 3 and 4, the cross shaft extends somewhat beyond the ends of the head of the T as indicated at 53 and 54 and projects into the hubs 55 and 56 of back pivot arms 57 and 58, respectively. As indicated more clearly in Figure 3, the projecting ends of the cross shaft within the hubs may be flattened and secured in place by pairs of set screws 60.

The pivot arms 57 and 58 may be in the form of an aluminum weldment or castings, for example, and extend outwardly and upwardly from beneath the seat 11 to horizontally aligned pivot hubs 62 and 63. From such hubs the back pivots continue upwardly extending initially rearwardly and inwardly as seen at 64 and 65 and then vertically upwardly as seen at 66 and 67. The seat back may include a cushion shell shown generally at 69 to which the upper ends of the back pivot arms are connected by fasteners 70 extending through vertically elongated slots 71. In this manner, the seat back may be vertically adjusted. The seat back pivot arms form from the cross shaft 50 to the center of hubs 62 and 63 the rear link of a four-bar linkage hereinafter more completely described.

As indicated, the hubs 62 and 63 are slightly above the seat bottom which is seen at 73 in Figure 2 and to each side thereof. The centers of such hubs are fairly close to the natural body pivot of the user. Each hub has journaled therein horizontally extending spindles 75 and 76 which extend outwardly from the tops of seat cradle hangers 77 and 78, respectively. Such hangers are secured to the upwardly curved ends of a square tube 80, and from such ends extend slightly outwardly and upwardly to the spindle. The hangers may also have a slight dog leg to the rear as seen in Figure 2. The square tube is curved upwardly to support removably and adjustably a shell 81 of the seat 11. The spindles 75 and 76 are the elements to which the arm rests are connected.

As seen more clearly in Figure 3, the spindles 75 and 76 may be journaled in such hubs by shouldered plastic bushings then secured in place by fasteners 83 and 84 extending into holes in the spindles and extending through plastic thrust washers 85. The fasteners 83 and 84 may also be used to secure removably in place the arm rests 17 and 18. Secured to the square tube and extending forwardly therefrom are two angle members 87 and 88 which complete the seat cradle. The two horizontally outwardly extending top flanges of such angles may be employed also to secure removably the seat shell 81 in place. Such adjustment may be obtained by fasteners and slots.

In any event, the seat cradle is rigidly secured to the seat shell which is in turn suspended from the pivots or pintles 75 and 76. The seat cradle and arms, generally designated at 90 forms a rigid L-shape link which is another link of such four-bar linkage.

At its forward end, the seat cradle is pivotally connected to the top of a relatively short front link 92, the sectional configuration of which is more clearly shown in Figures 5 and 6. The front link 92 includes a top hub 94 and a bottom somewhat larger hub 95 interconnected by a front web 96.

The top hub 94 is somewhat longer than the bottom hub an projects over the top of the base side plates 33 and 34 as seen in Figure 3. The front link is pivotally connected to the vertical flanges of the angles 87 and 88 of the cradle 90 by fasteners 97. The front link is also connected to the forwardly projecting side plates of the base or spring housing by fasteners 98. Such fasteners may extend through suitable sleeve and thrust and plastic bearings. In this manner, the front of the cradle is pivoted to the top of the front link which forms another link in such four-bar linkage.

The base or spring housing 10 which is fixed on top of the gas spring plunger and pivotally connected to the front link as well as a rear link forms the fourth bar of such four-bar linkage.

Reverting now to the springs and operation thereof, it will be seen that the spring 41 is compressed when the seat and back are tilted rearwardly. As seen in Figure 5 there is secured to the shaft 50 a spring actuator 99 which is clamped to such shaft for rotation therewith by clamp fasteners 100. The spring actuator includes a ball socket receiving the ball nose of spring plunger 101 which extends through the wall 47 and has secured thereto on the opposite side of such plate a washer 103. The spring plunger may be mounted in such plate on a plastic sleeve bearing and an elastomeric stop 104 is provided between the plate and the spring actuator. The spring actuator rocks with the shaft 50 and, as the shaft rocks in a clockwise direction as seen in Figure 5, the spring 41 is compressed. When it rocks in the opposite direction it disengages. The compression of the spring may be adjusted by rotation of threaded stud 106 threaded in wall 46. The stud includes a ball nose supporting spring retaining washer 107 confining the opposite end of the spring 41.

Referring now to Figure 6 it will be seen that the hub 95 of the front link includes a projecting arm 110 which includes a

bifurcated hook 111. The hook 111 is designed to engage transverse pin 112 on fixture 113 secured to the threaded end of rod 114 extending through a plastic bushing 115 in the plate 43. The opposite end of the rod is provided with adjustable lock nuts 117 which contain the spring 40 between the spring retainer 118 and the plate 43. Rotational movement of the front link in a counter clockwise direction as seen in Figure 6 from the position in Figure 6 will compress spring 40. Rotation in a clockwise direction will permit the spring to extend and continued rotation will permit the hook 111 to move away from the transverse pin 112.

Such springs maintain the seat of the chair in a substantially horizontal or neutral position. Forward tilting of the seat will cause the spring 40 to be compressed while rearward tilting of the seat will cause the spring 41 to be compressed.

Referring now to Figures 7 and 8, it will be seen that the seat back 12 may be provided with an optional shoulder support indicated at 120. The shoulder support may be vertically adjustably mounted on a leaf spring or the like 121 from the shell of the seat back.

Also indicated in Figures 7 and 8 are the interchangeable positions of the arm rests 17 and 18. Such arm rests are mounted on vertically extending arms or stanchions 123 and are laterally offset and may be vertically adjustably secured thereto through a multiple tooth or race and clamp mechanism. In this manner, the height of the arm rests may be adjusted.

Such arm rests may be secured to the outside of the spindles 75 and 76 simply by removing the fasteners 83 and 84 and the associated washers.

In this manner the arm rests may readily be removed and replaced and clamped in position. The angular position of the arm rests with respect to a vertical axis or the horizontal disposition of the seat may readily be in this manner adjusted if required. Also, it will be noted that the arm rests may be interchanged one for the other as seen in comparing Figures 7 and

8 so that a wider (Figure 7) or more narrow (Figure 8) dimension is provided between interiors of such arm rests. The lower ends of the arms of the arm rests are, of course, provided with suitable holes through which the fasteners 83 and 84 may extend to be locked to the seat cradle spindles projecting through the pivotal seat support. In this way the arms move in relationship to the seat. The result is that as the seat tilts forward and the back comes further forward less arm extends beyond the back rest to interfere with a desk or table edge, whereas, in rear tilt more arm is forward of the back rest.

Referring now to Figure 9, and in addition to Figure 2, it will be seen that the spring balanced four-bar linkage provides both forward and rearward tilting of the seat and back in a desired ratio.

As the seat and back rock backwardly with the rocking of the cross shaft 50 compressing the spring 41, the back may move to the phanton line position seen at 130 in Figure 2. The seat pivot for the suspended cradle also moves to the position 131 seen in Figure 2 through the arc indicated at 132. As the spindles for the seat support move rearwardly through such arc, the front link is drawn rearwardly through the arc 134 causing the seat to tilt rearwardly and upwardly through the arc indicated by the arrows 135. As indicated such ratio is approximately on the order of 1 to 3 for a seat/back tilt ratio.

As the seat tilts forwardly, the back pivot arm moves forwardly about the cross shaft 50 moving the seat to the phantom line position 137 and moving the principal seat pivot support or spindles through the arc 138 for rocking forward to the extent indicated by the arrows 139. This then pivots the front link 92 forwardly through the arc 140 against the pressure of the spring 40 tilting the seat forwardly and downward through the arc indicated by the arrows 141. In the forward mode, the tilt ratio of the back to the seat may be on the order of 2 to 1, respectively.

More specifically, in the illustrated linkage, when the seat tilts rearwardly it will move 18° and 30 ' while the seat tilts upwardly 6°. In the forward tilting mode, when the back tilts forwardly 13° the seat will tilt downwardly 6° and 30 '.

Referring to Figure 9 there is illustrated schematically the four-bar linkage which comprises the rear link 58, a top rigid L-shape link 78, 88, a relatively short front link 92 and a fixed or bottom link 10.

In addition, it will be seen that the seat back may be adjusted vertically as indicated by the arrows 150. The arm rests may be adjusted vertically as indicated by the arrows 151, and may be adjusted angularly about the seat pivot spindles as indicated by the arrows 152. Moreover, such arm rests 17 and 18 may be interchanged as indicated by the arrows 153 to provide the more narrow or wider seat seen in Figures 7 and 8. Also, the entire seat may be vertically adjusted through the gas spring as indicated by the arrows 154. Also, the seat may be adjusted to the front or rear in order to change seat depth in reference to the back, as indicated by the arrows 155.

In any event, there is provided a seat which includes the four-bar linkage indicated which includes a fixed link 10 having fixed pivots at each end. The front link pivots through the arc 156 in conjunction with the fore and aft pivot of the seat support spindles indicated by the arc 157. The entire mechanism is balanced in a neutral or a position wherein the seat is substantially horizontal both by the weight of the user and by the springs 40 and 41.

CLAIMS:

1. A chair comprising a seat, pivotal support means for said seat above and on each side thereof, means to rock said pivotal support means both fore and aft a neutral position wherein said seat is substantially horizontal, and a seat cradle pivotally suspended from said pivotal support means supporting said seat, said seat cradle forming one link of linkage means operative to pivot said seat inclined forwardly and also inclined rearwardly.

2. A chair as set forth in claim 1 including opposed spring means operative to hold said pivotal support means in the neutral position.

3. A chair as set forth in claim 1 wherein said pivotal support means is mounted on a pivot arm forming one bar of said linkage.

4. A chair as set forth in claim 1 wherein said linkage includes a fixed link supported on a pedestal.

5. A chair as set forth in claim 1 wherein said linkage includes a front link pivoted to said cradle and also to a fixed link, and also a pivot arm pivotally connected both to said fixed link and the other end of said cradle.

6. A chair as set forth in claim 1 including arm rests removably secured to said pivotal support means to pivot with said seat.

7. A chair as set forth in claim 1 including arm rests removably secured to said pivotal support means, each arm rest including a stanchion and a laterally offset arm rest so that such arm rests are interchangeable to widen or narrow the distance therebetween.

8. A chair as set forth in claim 1 wherein said seat cradle includes an L-shape rigid link.

9. A chair as set forth in claim 1 wherein said linkage means is a four-bar linkage means, and spring means acting on said four-bar linkage to maintain said linkage in a neutral position wherein said seat is substantially horizontal.

10. A chair comprising a seat and a back, and linkage means supporting said seat and back for both rearward and forward tilting from a neutral position in which said seat is in a substantially horizontal position.

11. A chair as set forth in claim 10 wherein said seat is supported by a cradle link pivoted from a position above and on each side of said seat and forwardly of said back.

12. A chair as set forth in claim 11 wherein said back is pivoted on a link pivoted below said seat, said link extending through said seat cradle link pivot.

13. A chair as set forth in claim 12 wherein said seat cradle link is also pivoted on a relatively short front link.

14. A chair as set forth in claim 13 wherein said front link and back link are pivoted to a fixed link.

15. A chair as set forth in claim 14 wherein said cradle link is L-shape.

16. A chair as set forth in claim 15 including spring means operative to return said seat and back to such neutral position.

17. A chair as set forth in claim 16 wherein said spring means comprises two springs acting on said front and back link respectively.

18. A chair as set forth in claim 10 wherein said linkage means is operative to pivot said seat and back rearwardly in a ratio greather than 1 to 1.

19. A chair as set forth in claim 16, wherein said ratio is approximately 3 to 1.

20. A chair as set forth in claim 10 wherein said linkage is operative to pivot said seat and back forwardly in a ratio of greater than 1 to 1.

21. A chair as set forth in claim 18 wherein said ratio is approximately 2 to 1.

22. A chair as set forth in claim 10 wherein said linkage means comprises a four-bar linkage including a fixed link, a back link, a front link and a seat link pivoted to the front and back links.

23. A chair as set forth in claim 22 wherein said back link extends from the seat link pivot adjustably to support the back.

24. A chair as set forth in claim 23 wherein such extension is rearwardly and then upwardly.

25. A chair as set forth in claim 24 including two back links extending from said fixed link, said seat link including two laterally spaced upwardly extending hangers pivoted to each back link.

26. A chair as set forth in claim 25 wherein said hangers of said seat link are interconnected beneath said seat by a strut, said seat cradle including a forwardly extending portion secured to said strut and pivoted to said front link.

27. A chair as set forth in claim 26 wherein said hangers form an essentially right angle with said forwardly extending portion of said seat link.

28. A chair as set forth in claim 26 wherein said strut is tubular and curved.

29. A chair comprising a seat and back, spring means supporting said seat in a stable substantially horizontal position, and linkage means supporting said seat and back for limited forward and rearward tilting against the pressure of said spring means.

30. A chair as set forth in claim 29 wherein said spring means comprises opposed springs, one being compressed upon rearward tilting and the other being compressed upon forward tilting.

31. A chair as set forth in claim 29 wherein said linkage is a four-bar linkage supporting said seat and back for rearward tilting in a ratio of about 1 to 3 respectively.

32. A chair as set forth in claim 31 wherein said linkage supports said seat and back for forward tilting in a ratio of about 1 to 2 respectively.

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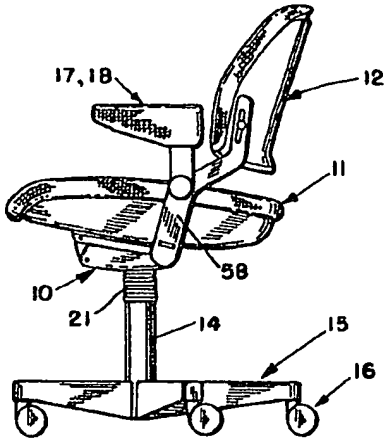

Fig. 1

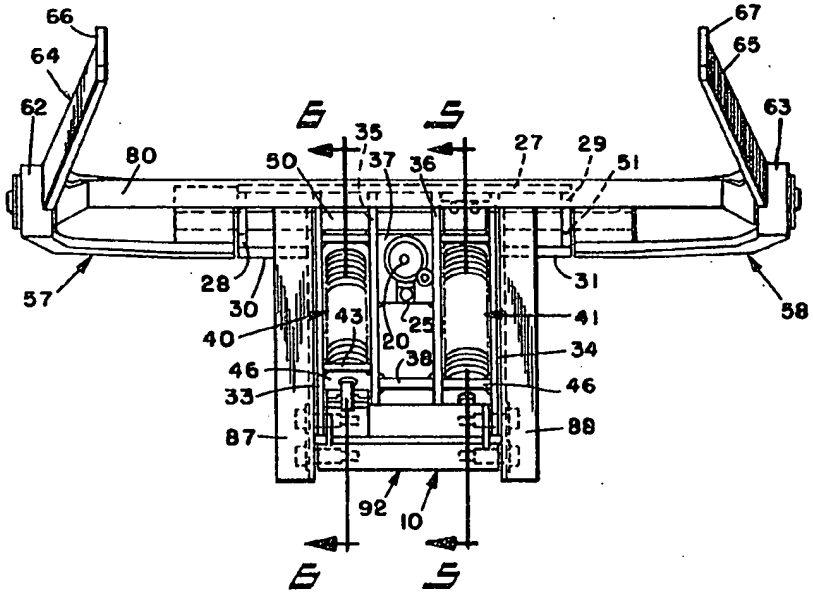

Fig. 4

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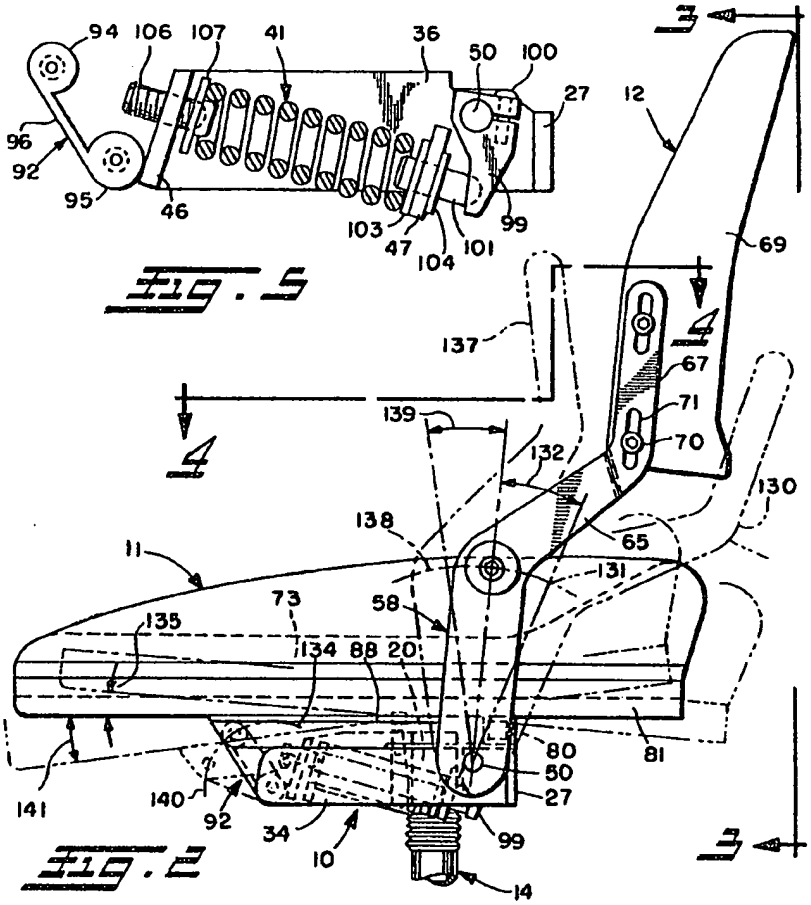

Fig. 5

Fig. 2

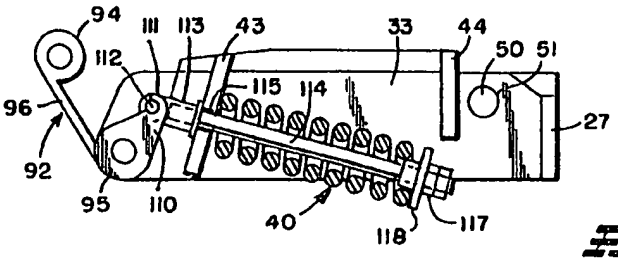

Fig. 6

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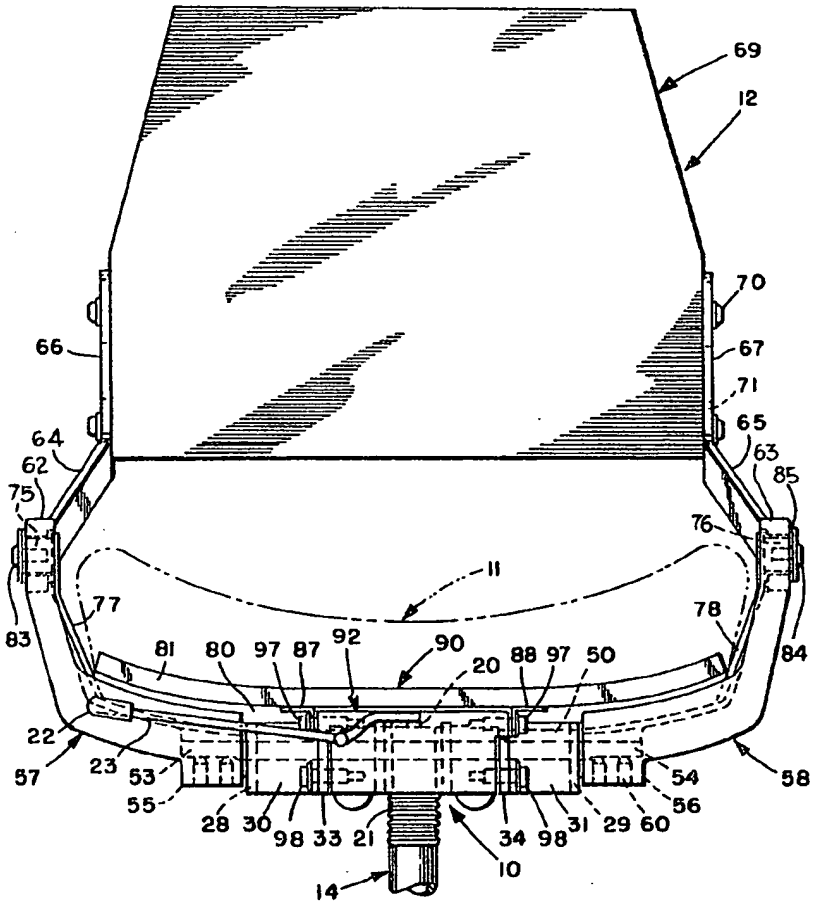

Fig. 3

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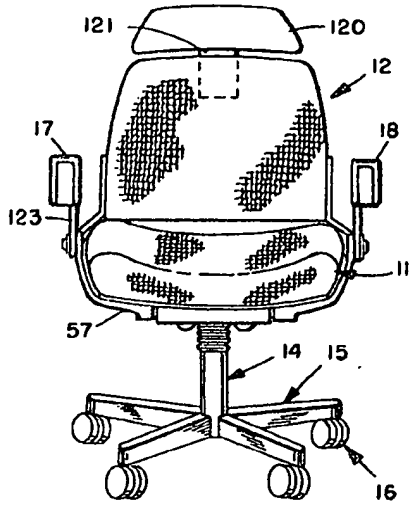

Fig. 7

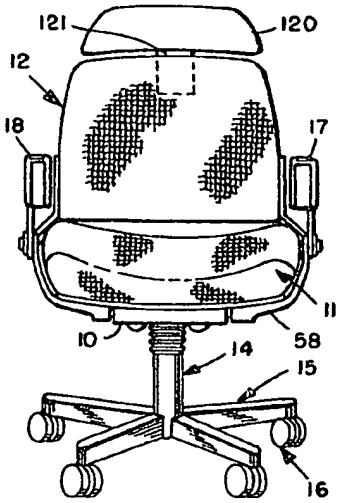

Fig. 8

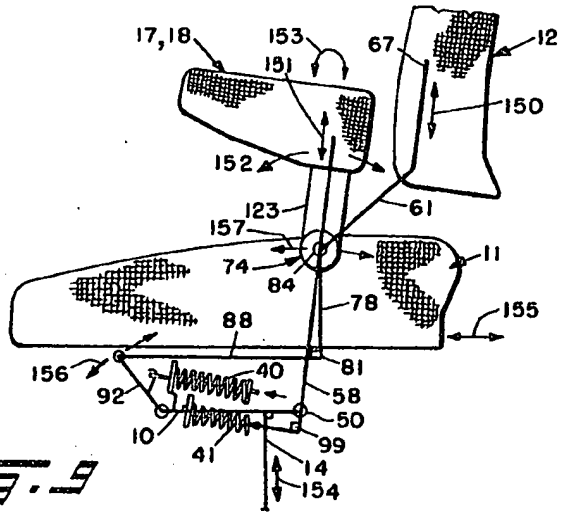

Fig. 9